

Two sides to every story: children learn words better from one storybook page at a time

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Running Head: ONE PAGE AT A TIME

Children Learn Words Better From One Storybook Page at a Time

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Abstract

Two experiments tested how the number of illustrations in storybooks influences 3.5-year-old children's word learning from shared reading. In Experiment 1, children encountered stories with either two regular-sized A4 illustrations, one regular-sized A4 illustration, or one large A3-sized illustration (in the control group) per spread. Children learned significantly fewer words when they had to find the referent within two illustrations presented at the same time. In Experiment 2 a gesture was added to guide children's attention to the correct page in the two illustrations condition. Children who saw two illustrations with a guiding gesture learned words as well as children who had seen only one illustration per spread. Results are discussed in terms of the cognitive load of word learning from storybooks.

Two Sides to Every Story: Children Learn More Words From Storybooks with Single Illustrations per Page

Sharing illustrated storybooks is a common activity for parents and young children (e.g., Rideout, Vanderwater, & Wartella, 2003) and provides a richer source of vocabulary than everyday conversation (Montag, Jones, & Smith, 2015). Several studies demonstrate that the styles of illustrations influence how well children learn from books (Ganea, Canfield, Simons-Ghafari, & Chou, 2014; Ganea, Pickard, & DeLoache, 2008; Tare, Chion, Ganea, & DeLoache, 2010; Waxman, Hermann, & Woodring, 2014). However, little is known about how the *number* of illustrations influences learning. The current experiments investigate how well children learn new words from storybooks when they view one or two illustrated scenes at a time.

Pre-literate children rely on illustrations to help them make sense of the story content (for a review see, Wagner, 2013). Specifically, in an eye-tracking study, Justice, Skibbe, Canning, and Lankford (2005) found 4-year-old kindergarten children looked longer at the illustrations than the print that accompanied complicated texts, indicating that even with some emerging print awareness, children look primarily at illustrations. In another eye-tracking study, Evans and Saint-Aubin (2005) found that even with a range of illustration styles, preschool children spent the majority of their time looking at illustrations and only 6% of their time looking at the printed text (for similar findings, see e.g., Roy-Charland, Perron, Boulard, Chamberland, & Hoffman, 2015; Roy-Charland, Saint-Aubin, & Evans, 2007).

Pre-literate children have a growing awareness of reading conventions, such as, print conveys meaning and is read from left-to-right and top-to-bottom (for a review see International Reading Association & The National Association for the Education of Young Children, 1998; Snow, Burns, & Griffin, 1998). However, because they cannot yet read, young children are

unlikely to know when the reader has moved from the left-hand page to the right-hand page. That is, children may be unable to determine which illustrated scene represents which part of the story. Thus, multiple illustrated scenes displayed simultaneously may make it more challenging to associate new words with their illustrated representations.

When learning from picture books, i.e., books that include isolated images of one or very few objects or people presented as line drawings or photographs (e.g., Ganea et al., 2008; Ganea, Preissler, Butler, Carey, & DeLoache, 2009), children may be able to use mutual exclusivity to determine which object to attend to. That is, presenting multiple illustrations per spread may not be overly challenging because children may understand that if the left image is a toy telephone, then the word *blicket* must refer to the right image, i.e., the chrome wire egg holder (Ganea et al., 2008). Most studies in which children can determine the referent of a novel word using mutual exclusivity do not teach words from storybooks but rather use highly-structured experimental designs with novel objects in a referent selection task (e.g., Markman, Wasow, & Hansen, 2003) or images of novel objects in a preferential looking task (e.g., Halberda, 2006). In such cases, 3-year-old children learn words best when another object *is* present and struggle with only one image at a time (Zosh, Brinster, & Halberda, 2013). A potential explanation for this effect is that word learning involves remembering both what something is and what it is not (e.g., McMurray, Horst & Samuelson, 2012; Axelsson, Churchley & Horst, 2012). However, commercially-available storybooks like *The Gruffalo* by Julia Donaldson or *Goodnight Moon* by Margaret Wise Brown often include rich illustrated scenes containing multiple items. How such illustrated scenes influence word learning has been neglected in the word learning from shared storybook reading literature.

Although children struggle to learn object names when only one object is present (Zosh et al., 2013), they also struggle when too many objects are present (Horst, Scott, & Pollard, 2010). Thus, optimal word learning tasks must be not too hard, but not too easy. Indeed, evidence suggests that word learning is particularly challenging for children when increasing amounts of perceptual information are presented. For example, children struggle to learn object names when target object categories are highly variable (Twomey, Ranson, & Horst, 2014) target objects are presented in less predictable locations (Benitez & Smith, 2012), and with multiple combinations of extraneous objects, rather than the same combinations repeated (Axelsson & Horst, 2014). Such findings are consistent with cognitive load theory (Sweller, 1998, 1989 or see, Paas, Renkl, & Sweller, 2003 for a review), which explains how working memory capacity is inherently limited and is especially problematic in situations with extraneous information. Thus, reducing extraneous perceptual information helps children focus on the target information, which then improves learning. For example, Son, Smith, and Goldstone (2008), reduced cognitive load by providing simplified depictions of novel objects and found that this promoted better generalization of novel objects than more complex examples. Whether decreasing the number of illustrated scenes presented simultaneously in a storybook also decreases the cognitive load of word learning from shared storybook reading remains unknown.

In the current experiments we investigate whether decreasing the number of storybook illustrations presented simultaneously increases preschool children's ability to learn words incidentally from shared storybook reading. All children were presented with three storybooks that included illustrated scenes of a family's activities. The same two novel objects were included across the scenes and were named on the pages on which they were depicted (four pages for each object). Critically, all children heard the same three stories and saw the same 10 illustrations per

story, however, the number of illustrations presented simultaneously and guidance varied across conditions. In Experiment 1, children saw either two illustrations (one scene on each page of the open book) or one illustration (only on the right-hand page with the other side blank). Children in a control condition saw a large storybook (cf. Big Book Reading, Tse & Nicholson, 2014) with one illustrated scene on the same size as the two illustrations combined. If decreasing the number of illustrations also decreases the cognitive load of word learning from storybooks then children should learn more words when they see only one illustration at a time. In contrast, if the number of illustrations does not affect cognitive load, then children should learn words equally from one- or two-illustration books. In Experiment 2, we investigate whether guiding children's attention to the correct page with a simple gesture helps children focus on the correct page and improves word learning—even with two illustrations.

Experiment 1

Method

Participants. Thirty-six 3.5-year-old children ($M = 41.99$ months, $SD = 1.76$ months, range = 38.87-45.14 months) participated. Children were monolingual, British-English speakers from predominantly middle-class families. All children were typically developing with no reported speech or language difficulties. Twelve children each were randomly assigned to one of the three conditions: one illustration ($M = 41.87$, $SD = 0.65$, 6 girls), two illustrations ($M = 42.85$, $SD = 0.43$, 6 girls), or control condition (one large illustration, $M = 41.92$, $SD = 0.45$, 6 girls). Maternal education accounts for variability in children's vocabulary (e.g., Richels, Johnson, Walden, & Conture, 2013). Because vocabulary scores were not available for children in the current study we compared maternal education. There was no difference in maternal education levels between conditions, Fisher's Exact Test = 3.71, $p = .98$. Two mothers each in the one and two illustrations

conditions and three mothers in the control condition had completed high school (GCSEs and/or A-levels) and/or completed a vocational diploma or access course. Eight mothers each in the one and two illustrations conditions, and six in the control condition had an undergraduate degree and/or an undergraduate degree with a postgraduate certificate (e.g., Postgraduate Certificate in Education (PGCE), an additional teaching qualification). One mother each in the one illustration and control conditions had a Master's degree and one mother in each condition had a doctoral degree. One mother in the two illustrations condition and one mother in the control condition declined to answer this question. Parents were reimbursed for travel costs and children chose a small gift as a thank you for participating (e.g., a colouring book).

Storybooks. Stimuli included three 10-page storybooks slightly modified from Horst, Parsons, and Bryan (2011) *The Very Naughty Puppy*, *Nosy Rosie at the Restaurant*, and *Rosie's Bad Baking Day*. Each storybook depicted and named the same two novel objects four times. There were no other novel words in the storybooks. We only included two targets because preschool children's word learning abilities are limited (Bion, Borovsky, & Fernald, 2013). Each object had a function: the orange inverted slingshot functioned like a hand mixer (*tannin*) and the metal kinetic wheel was used like a rolling pin (*sprock*). Throughout each story, objects were named incidentally and were not the focus of the story. The objects appeared twice on their own pages and twice together. We used real photographs edited with the poster edges feature in Photoshop to make them look like drawings typical of a commercially available children's book. Across storybooks there was no difference in the number of words per page, $M = 45$, $SD = 9.34$, $F(2,24) = 0.98$, $p = .39$.

All children heard the same stories and saw all of the illustrations for each story. The only difference between conditions was the way the storybooks were printed (see Figure 1): children

either heard stories with two A4 illustrated scenes per open spread, one A4 illustrated scene per spread (i.e., the left-hand page was always blank), or one A3 illustrated scene per spread. In the ISO A-series paper system (i.e., European standard), A3 pages (29.70 x 42.00 cm) are twice the size of A4 pages (21.00 x 29.70 cm), thus the A3 condition served as a control condition where the storybooks included only one illustration per spread (as in the one A4 illustration condition) but included the same overall illustrated area as the two A4 illustrations condition). Because the one illustrations condition differed from the two illustrations condition in both surface area and amount of items/details, we wanted to include a control condition to disentangle which of these was driving any effects we might obtain. Equating the number of items/details would have precluded presenting all children with the same illustrations; therefore, we chose to test surface area as the control condition. Data from all three conditions were collected at the same time.

When two illustrated scenes were displayed simultaneously (i.e., in the two illustrations condition), these scenes reflected different aspects of the plot so were sometimes set in different rooms or with different characters (see Figure 1). For example, in *Rosie's Bad Baking Day*, page 4 displays the kitchen tools and ingredients Rosie puts on the counter, including the sprock and tanning among several items and page 5 depicts Rosie holding the salt instead of the sugar as she is about to stir her dough with the tannin.

Enjoyment ratings. Three emoticons were printed in a row on a single laminated card and each paired with the responses “liked a lot”, “liked a little”, and “didn’t like” (see also, Williams & Horst, 2014).

Test stimuli. An A4 test booklet with images of four novel objects per right-hand page was used on the test trials (the left-hand pages were blank). On each page, four objects were presented on a plain white background without any other contextual information (see Figure 2).

Across test trials the targets (*tannin* and *sprock*) were presented with four additional novel objects that the children had not previously seen, so that each trial would present children with a different combination and it would not appear that a question was being repeated. That is, novel objects and their locations varied across trials. Finally, a practice trial page included images of four known objects: a dog, a plane, a duck and a chair.

Procedure. Each child was tested individually in a children's lab at the university. During the reading phase, the experimenter sat opposite the child and held the storybook upright, to her side, with the pages facing the child, like a teacher would when reading to a group of children. The parent sat on a seat in a different corner of the room. All children were read each of the three stories. For each child all three stories were presented in the same format (e.g., two illustrations per spread). No dialogic techniques, such as giving definitions for novel words or pointing, were used during the readings. Story-order was counterbalanced across children.

After each story the experimenter showed children the enjoyment ratings cards and asked children whether they “liked the story a lot,” “liked the story a little,” or “didn’t like the story at all,” while simultaneously pointing to the corresponding emoticon. We included this measure to ensure differences in word learning could not be attributed to differences in enjoyment across conditions. Children indicated their choices by pointing to the emoticon, often with verbal confirmation. For half of the children the order enjoyment ratings were presented from “liked the story a lot” to “didn’t like the story at all” and for half the children the order was reversed.

After reading the final story, the experimenter tested word learning using the test booklet, which did not include illustrated scenes, rather isolated images of objects. The test phase began with four warm-up trials to get the child used to pointing to pictures in the test booklet and to ensure the child understood the task. Warm-up pages included images of only highly familiar

objects. The experimenter opened the test booklet to one of the warm-up trial pages and asked the child to point to one of the familiar objects (e.g., “can you point to the plane?”). Across the four counterbalanced warm-up trials, children were asked to point to an object in each quadrant of the page. Test pages included images of only novel objects, thus children could not solve these trials by using process of elimination. On each trial the experimenter turned to a different test page and asked the child to point to one of the novel objects. In total children were asked to point to each target novel object twice (see also Werchan & Gómez, 2014). On half of the trials only one target was present (e.g., the *sprock* with three other novel objects) and on half of the trials both targets were present (e.g., the *sprock* and *tannin* with two other novel objects). Trial order, page and quadrant were counterbalanced across participants.

Results

Individual story reading durations ranged from 105 to 230 seconds ($M = 146.48s$, $SD = 2.11s$). Preliminary analyses indicated no effect of illustration format on children’s average reading durations between conditions, $F(2,33) = 0.23$, $p = .79$, $\eta^2 = 0.01$.

Enjoyment ratings. Overall, children generally reported that they liked the stories (37%) and liked them a lot (45%). There was no difference between conditions in the total numbers of “a lot,” “liked” and “not at all” in children’s enjoyment ratings, $X^2(4) = 4.46$, $p = .38$. There was also no difference between stories, $X^2(4) = 4.41$, $p = .35$.

Word learning. Children in the one illustrations condition ($M = 0.75$, $SD = 0.34$, $t(11) = 5.14$, $p < .001$, $d = 1.48$) and in the control (one large) condition ($M = 0.75$, $SD = 0.30$, $t(11) = 5.75$, $p < .001$, $d = 1.66$), chose the target objects more than expected by chance (.25) see Figure 3, Left Panel. However, with Bonferroni’s correction to correct for Type-I error ($p = .017$), children in the two illustrations condition did not chose the target objects more than expected by chance (M

$= 0.44$, $SD = 0.28$, $t(11) = 2.28$, $p = .04$, $d = .66$). Additional analysis confirmed that there was no effect of novel object (sprock, tannin) on children's responses, $F(1,33) = .34$, $p = .56$, $\eta_p^2 = 0.01$.

To test for differences between illustration formats, children's proportions of correct choices were entered into an ANOVA with illustration format (two, one, one large) as between-subjects factor. The ANOVA yielded a main effect of illustration format, $F(2, 33) = 4.10$, $p = .03$, $\eta_p^2 = 0.20$. Planned contrasts showed that children who saw two illustrations learned words less well than children who saw one illustration per spread, $t(33) = 2.87$, $p = .007$, $\eta_p^2 = 0.20$. There was no difference in word learning between one illustration in A4 or one illustration in A3 $t(33) = 0.00$, *ns*. Thus, illustration size did not affect word learning, but the number of illustrations did.

Discussion

Many illustrated storybooks are printed with two illustrations per spread (e.g., *In the Night Kitchen* by Maurice Sendak or *Dinosaur Roar!* By Paul and Henrietta Stickland)—if not more (e.g., *The Incredible Book Eating Boy* by Oliver Jeffers contains 6 illustrations on pages 7-8). Further, some books include a combination of one or more illustrations per spread (e.g., *The Smartest Giant in Town* by Julia Donaldson). Our goal is not to suggest that all of these books be reprinted. However, because young children do not necessarily know when the text is referring to the left- or right-hand page, they may benefit from a non-verbal gesture to look to the correct page. Specifically, a non-verbal signal may help children to focus on the correct illustration at the correct time, thus improving their chances of learning new words from the storybook (cf. Booth, McGregor, & Rohlfing, 2008). Gestures support word learning from stories above and beyond reading without gestures (e.g., Rohlfing, Grimminger, & Nachtigaller, 2015; Sénéchal, 1997).

Thus, in Experiment 2 we again read children storybooks with two illustrations per spread, but included a quick sweeping hand gesture to indicate which page we were reading from to help

focus children's attention to the correct illustration. We chose a sweeping gesture over the other possible techniques to keep the manipulation visual without additional auditory information. We did not use a pointing gesture because it would limit the gesture to a specific area or object on the page and our aim was to draw children's attention to the general area, or whole page, lest the word learning not be incidental. We also wanted to perform the same gesture on every page and some pages did not include a novel object, while others included both novel objects. Thus, by not pointing directly at the novel objects, this sweeping gesture allowed us to maintain an incidental word learning task (Rice, 1990) as opposed to providing ostensive reference. If storybooks with one illustrated scene per spread are more helpful than storybooks with two illustrated scenes because children do not know which page to look at, then guiding them towards the correct page should improve word learning to similar levels as those from single illustration displays.

Experiment 2

Method

Participants. An additional twelve 3.5-year-old children ($M = 40.45$ months, $SD = 1.30$ months, range = 38.45 to 45.03 months, 6 girls) participated. Children were monolingual, British-English speakers with no reported speech or language difficulties. Two mothers had completed high school (GCSE's and/or A-levels), seven had an undergraduate degree or an undergraduate degree with a postgraduate certificate. One mother had completed a Master's degree, one a doctoral degree and one declined to provide this information. Parents were reimbursed for travel costs and children chose a small gift as a thank you for participating (e.g., a colouring book).

Stimuli. The same stimuli were used as in the two illustrations condition in Experiment 1.

Procedure

All children were read the two illustrations storybooks. The procedure was the same as in Experiment 1 except that before reading each page, the experimenter smoothly swept her open hand from the top of the page to the bottom, thereby drawing children's attention to the correct page.

Results

Individual story reading durations ranged from 131 to 298 seconds ($M = 158.86s$, $SD = 30.45s$). There was no significant difference in average reading durations between children in this experiment and children in the two illustrations condition of Experiment 1 ($M = 148.81s$, $SD = 20.34s$), $t(22) = 1.26$, $p = .22$, $d = 0.43$. Thus, adding a simple sweeping gesture only added on average 1 second per page to the time needed to read a story.

Enjoyment ratings. Overall, children generally reported that they liked the stories (61%) and like them a lot (19%). Again, there was no difference between stories, Fisher's Exact Test, $p = .50$.

Word Learning. Children learned the words from the story (see Figure 3, Right Panel). Specifically, children chose the target object more than expected by chance ($M = 0.88$, $SD = 0.17$, $t(11) = 12.84$, $p < .001$, $d = 3.71$). Again, there was no effect of novel object (sprock, tannin) on children's responses, $t(11) = -.69$, $p = .50$, $d = -0.20$.

Our goal was to determine whether adding a simple gesture would be sufficient to improve children's word learning from storybooks with two illustrations per spread. Thus, we compared the word learning performance of children in the current study to children in the two illustrations condition of Experiment 1. Children who had the additional support to guide their attention to the correct page learned words significantly better than children who did not have that support, $t(22) = 4.58$, $p < .001$, $d = 8.78$.

Discussion

In Experiment 2 we investigated whether orienting children's attention to the correct storybook page with a simple gesture while reading could diminish the effects of cognitive load from multiple illustrated scenes found in Experiment 1. Adding the gesture did not significantly increase the amount of time needed to read the story, but did significantly improve children's word learning compared to reading without a guiding gesture.

The rates of word learning observed in Experiment 2 are similar to other studies using dialogic reading techniques, such as pointing or asking questions (e.g., Elley, 1989; Sénéchal, Thomas, & Monker, 1995; Walsh & Blewitt, 2006). For example, Ard and Beverly (2004) read storybooks to 3- and 4-year-old children either verbatim or with one of three dialogic techniques; added questions, added comments, or both questions and comments. Children learned approximately 75% of the new vocabulary with the dialogic reading techniques included but only 53% with verbatim readings. Although the efficacy of the use of dialogic techniques to improve children's word learning from storybooks is not in doubt, multiple dialogic techniques are often employed in combination, making it harder to compare effects across the literature for individual techniques (see Wasik, Hindman, & Snell, 2016 for a recent review). It is therefore particularly exciting to see that such a simple, imprecise gesture could have such powerful effects on children's learning.

General Discussion

Across two experiments we investigated whether decreasing the number of storybook illustrations presented simultaneously increases preschool children's ability to learn words from shared storybook reading. In Experiment 1 we read children 10-page stories with either one, two, or one large illustration per spread. Children learned the new words better when presented with only one

illustration per spread, regardless of the image size, even though all children saw the same number of illustrations overall. In Experiment 2 we read children the same stories with two illustrations per spread, but added a small sweeping gesture to narrow their field of attention and indicate which page we were reading, thus providing a solution for overcoming the cognitive load burden of multiple illustrations. Although children in this condition were presented with multiple illustrations at once, they were able to focus their attention to learn more words than expected by chance and more words than children who were presented with the same number of illustrations but no guidance on which page to attend to. Taken together these findings suggest that children's word learning is improved by helping children focus on the relevant information by either reducing the number of illustrations presented simultaneously (Experiment 1), or directing their attention to the correct illustration (Experiment 2). Previous studies have demonstrated that children's word learning is also improved by reading the same short story repeatedly compared to reading one longer story (McLeod & McDade, 2011) or reading different stories (Horst et al., 2011; Williams & Horst, 2014). However, in those studies the number of illustrations presented to children over the course of the reading sessions differed between conditions (although the number of target word exposures was the same). The current study is the first to maintain both the number of target word exposures and the number of illustrations across conditions.

These findings are consistent with cognitive load theory (Paas et al., 2003; Sweller, 1988, 1989), which suggests that extraneous information can prevent optimal learning. The more information children need to think about, the more challenging the task. Consequently, removing extraneous perceptual information may improve learning (see, e.g., Son et al., 2008). For example, kindergarten children are better able to learn information from science lessons when the extraneous information of a highly-decorated classroom is removed (Fisher, Godwin, & Seltman, 2014).

Similarly, reducing the amount of extraneous information in graphs improves children's mathematics skills (Kaminski & Sloutsky, 2013) and removing extraneous information in ABC books improves alphabet learning (Chiong & DeLoache, 2012). However, children do struggle when the learning situation is overly simplified, for example when no extraneous information is present (e.g., Zosh et al., 2013). In the current study, in the two illustrations format, children are faced with processing additional materials—which in some cases may even provide conflicting information—slowing down the process of word learning. Children do not know when the story moves from one illustration to the other. In contrast, in the one illustration format, the child is provided with only the relevant scene, which corresponds with the text they are currently hearing, thereby reducing the cognitive load associated with understanding the story and the new words. Similarly in Experiment 2, children are directed towards the relevant scene, thereby reducing cognitive load.

In the real world children's literature includes both picture books of decontextualized pictures and stories with rich illustrated scenes. Thus, a single page can have any number of items on it, which adds to the challenge of identifying and determining the referent for a new word. We know the number of items visually presented to children influences learning about both words and objects (e.g., Horst et al., 2010; Oakes & Ribar, 2005; Thom & Sandhofer, 2009; Zosh et al., 2013). In the current study we read children storybooks with illustrated scenes containing multiple items to examine how the amount of extraneous visual information affects incidental word learning. Because the illustrations were rich and complex, there was always at least some distractor item present (cf. Zosh et al., 2013) and children could use the cross-situational regularities across pages to learn the name-object associations via gradual associative learning (see Smith & Yu, 2008; McMurray et al., 2012). Several studies have presented books consisting of simplified drawings

(e.g., Ganea et al., 2008) which might have a different effect on word learning (see for example related findings with simplified objects, Smith, 2003). However, studies using picture books with simplified drawings often focus on children's learning of object categories and not word learning (but see for example, Read, 2014). Future research is needed to further explore the roles of attention and perception in children's word learning from both storybooks with illustrated scenes and picture books with simplified drawings. Furthermore, these findings might differ for older children who have more extensive vocabularies or in children from other SES or linguistic backgrounds. Future research should also explore how prior vocabulary knowledge interacts with attention in word learning from storybooks. Vocabulary scores were not available for children in the current studies.

Although children in the current studies learned target words better when presented with single illustrations, there may be benefits for other types of learning from multiple illustrations. For example, story comprehension may be better supported by having more to look at, particularly as visual attention to illustrations during storybook reading predicts story comprehension (Kaefer, Pinkham, & Neuman, 2016). Therefore, future research is needed to understand how the number of illustrated scenes influences other types of learning from storybooks, beyond that of learning names for objects.

The current findings add to a growing literature on the usefulness of dialogic techniques for teaching words from storybooks. Dialogic techniques include providing definitions (Coyne, Simmons, Kame'enui, & Stoolmiller, 2004), asking children questions (Walsh & Blewitt, 2006) and asking children to point to items on the page (Sénéchal et al., 1995). During shared storybook reading adult pointing helps children attend to specific items (Roy-Charland et al., 2015) and facilitates vocabulary growth (Sénéchal, 1997). Here we demonstrate another non-pointing gesture

also facilitates word learning from storybooks. Importantly, our sweeping gesture dramatically improved word learning from storybooks without significantly increasing the amount of time it took the adult to read the story. However, we only tested children's ability to learn concrete nouns, but there may be differences in the effect of gesturing on learning other word classes, which might benefit from more specific pointing.

The current findings may also be informative for research comparing e-books (i.e., storybooks presented on screens) with traditional two-illustration paper storybooks. Some studies report a deficit in learning from e-books (e.g., Segers, Takke, & Verhoeven, 2004) while others do not (e.g., Korat & Shamir, 2007; Segal-Drori, Korat, Shamir, & Klein, 2010). One explanation for this discrepancy is that e-books often contain added manipulative features, which influences parent-child interactions and affects learning (Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff, & Collins, 2013). For example, e-books often contain additional games (e.g., de Jong & Bus, 2002) or interactive dictionary features (e.g., Korat, 2009). Previous research indicates that added manipulative features such as pull-tabs hinder learning from paper books (Tare et al., 2010), however some features of e-books may be helpful in the same way as dialogic techniques by highlighting key information at the right time. Another explanation is that e-books are often viewed only one illustration at a time (e.g., Verhallen & Bus, 2011), which could be an additional confounding factor when comparing between storybook media types. The current findings suggest that such single illustrations help children focus their attention on relevant information and may aid learning especially when children are exploring books without an adult.

This paper is the first to examine how the amount of illustrations (both number and surface area) influences word learning. The current experiments demonstrate that reducing the number of simultaneous illustrations to just one at a time improves children's word learning from shared

storybook reading. Given that we do not wish readers to start cutting up their books so they can show children one illustration at a time, we provide a solution for overcoming the cognitive load burden of multiple illustrations—the gesture manipulation in Experiment 2. That is, when altering the number of illustrations is not possible, providing a simple gesture to generally direct children’s attention to the correct page provides sufficient support to enable word learning in this otherwise complicated learning situation. These findings have important implications for educational research and suggests that even seemingly minor differences in illustration format and providing scaffolding cues can result in significant differences in how well children learn. These findings should help shape future storybook research design, and provide useful practical solutions, which could be used by teachers and parents alike and may inform our understanding of how to create eBooks and other media that children may encounter without an adult. Furthermore, in an age of seemingly endless possibilities, they provide a stark reminder that less is sometimes more.

References

- Ard, L. M., & Beverly, B. L. (2004). Preschool word learning during joint book reading: Effect of adult questions and comments. *Communication Disorders Quarterly*, 26(1), 17-28. doi: 10.1177/15257401040260010101
- Axelsson, E. L., & Horst, J. S. (2014). Contextual repetition facilitates word learning via fast mapping. *Acta Psychologica*, 152, 95-99. doi: 10.1016/j.actpsy.2014.08.002
- Benitez, V. L., & Smith, L. B. (2012). Predictable locations aid early object name learning. *Cognition*, 125, 339-352. doi: 10.1016/j.cognition.2012.08.006
- Bion, R., A. H., Borovsky, A., & Fernald, A. (2013). Fast mapping, slow learning: Disambiguation of novel word-object mappings in relation to vocabulary learning at 18,24, and 30 months. *Cognition*, 126, 39-53. doi: 10.1016/j.cognition.2012.08.008
- Booth, A. E., McGregor, K. K., & Rohlfing, K. J. (2008). Socio-pragmatics amd attention@ Contributions to gesturally guided word learning in toddlers. . *Language Learning and Development*, 4(3), 179-202. doi: 10.1080/15475440802143091
- Chiong, C., & DeLoache, J. (2012). Learning the ABCs: What kinds of picture books facilitate young chidlren's learning? *Journal of Early Childhood Literacy*, 13(2), 225-241. doi: 10.1177/1468798411430091
- Coyne, M. D., Simmons, D. C., Kame'enui, E. J., & Stoolmiller, M. (2004). Teaching vocabulary during shared storybook readings: An examination of differential effects. *Exceptionality*, 12(3), 145-162. doi: 10.1207/s15327035ex1203_3
- de Jong, M. T., & Bus, A. G. (2002). Quality of book-reading matters for emergent readers: An experiment with the same book in a regular or electronic format. *Journal of Educational Psychology*, 94, 145-155. doi: 10.1037/0022-0663.94.1.145

- Donaldson, J. (2002). *The smartest giant in town*. UK: Macmillan Children's Books.
- Elley, W. B. (1989). Vocabulary acquisition from listening to stories. *Reading Research Quarterly*, 24(2), 174-187. doi: 10.2307/747863
- Evans, M. A., & Saint-Aubin, J. (2005). What children are looking at during shared storybook reading: Evidence from eye movement monitoring. *Psychological Science*, 16(11), 913-920. doi: 10.1111/j.1467-9280.2005.01636.x
- Fisher, A. V., Godwin, K. E., & Seltman, H. (2014). Visual environment, attention allocation, and learning in young children. When too much of a good thing may be bad. *Psychological Science*, 25(7), 1362-1370. doi: 10.1177/0956797614533801
- Ganea, P. A., Canfield, C. F., Simons-Ghafari, K., & Chou, T. (2014). Do cavies talk? The effect of anthropomorphic picture books on children's knowledge about animals. *Frontiers in Psychology*, 5(283). doi: 10.3389/fpsyg.2014
- Ganea, P. A., Pickard, M. B., & DeLoache, J. (2008). Transfer between picture books and the real world by very young children. *Journal of Cognition and Development*, 9(1), 46-66. doi: 10.1080/15248370701836592.
- Ganea, P. A., Preissler, M. A., Butler, L., Carey, S., & DeLoache, J. S. (2009). Toddlers' referential understanding of pictures. *Journal of Experimental Child Psychology*, 104(3), 283-295. doi: :10.1016/j.jecp.2009.05.008
- Halberda, J. (2006). Is this a dax which I see before me? Use of the logical argument disjunctive syllogism supports word-learning in children and adults. *Cognitive Psychology*, 53(4), 310-344. doi: 10.1016/j.cogpsych.2006.04.003

- Horst, J. S., Parsons, K. L., & Bryan, N. M. (2011). Get the story straight: contextual repetition promotes word learning from storybooks. *Frontiers in Psychology*, 2. doi: 10.3389/Fpsyg.2011.00017
- Horst, J. S., Scott, E. J., & Pollard, J. A. (2010). The role of competition in word learning via referent selection. *Developmental Science*, 13(5), 706-713. doi: 10.1111/j.1467-7687.2009.00926.x
- International Reading Association, & The National Association for the Education of Young Children. (1998). Learning to read and write: Developmentally appropriate practices for young children. *The Reading Teacher*, 52(2), 193-216.
- Jeffers, O. (2007). *The incredible book eating boy*. NY, USA: Penguin Group.
- Justice, L. M., Skibbe, L. E., Canning, A., & Lankford, C. (2005). Pre-schoolers, print and storybooks: An observational study using eye movement analysis. *Journal of Research in Reading*, 28(3), 229-243. doi: 10.1111/j.1467-9817.2005.00267.x
- Kaefer, T., Pinkham, A. M., & Neuman, S. B. (2016). Seeing and knowing: Attention to illustrations during storybook reading and narrative comprehension in 2-year-olds. *Infant and Child Development*, e2018. doi: 10.1002/icd.2018
- Kaminski, J., A., & Sloutsky, V. M. (2013). Extraneous perceptual information interferes with children's acquisition of mathematical knowledge. *Journal of Educational Psychology*, 105(2), 351-363. doi: 10.1037/a0031040
- Korat, O. (2009). The effects of CD-ROM storybook reading on Israeli children's early literacy as a function of age group and repeated reading. *Education and Information Technologies*, 14(1), 39-53. doi: 10.1007/s10639-008-9063-y

- Korat, O., & Shamir, A. (2007). Electronic books versus adult readers: effects on children's emergent literacy as a function of social class. *Journal of Computer Assisted Learning*, 23(3), 248-259. doi: 10.1111/j.1365-2729.2006.00213.x
- Markman, E. M., Wasow, J. L., & Hansen, M. B. (2003). Use of the mutual exclusivity assumption by young word learners. *Cognitive Psychology*, 47(3), 241-275. doi: 10.1016/s0010-0285(03)00034-3
- McLeod, A. N., & McDade, H. L. (2011). Preschoolers' incidental learning of novel words during storybook reading. *Communication Disorders Quarterly*, 32(4), 256-266. doi: 10.1177/1525740109354777
- Montag, J., L., Jones, M. N., & Smith, L., B. (2015). The words children hear: Picture books and the statistics for language learning. *Psychological Science*, 26(9), 1489-1496. doi: 10.1177/0956797615594361
- Oakes, L. M., & Ribar, R. J. (2005). A comparison of infants categorization in paired and successive presentation familiarization tasks. *Infancy*, 7(1), 85-98. doi: 10.1207/s15327078in0701_7
- Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive Load Theory and Instructional Design: Recent Developments. *Educational Psychologist*, 38(1), 1-4. doi: 10.1207/s15326985ep3801_1
- Parish-Morris, J., Mahajan, N., Hirsh-Pasek, K., Golinkoff, R. M., & Collins, M. F. (2013). Once upon a time: Parent-child dialogue and storybook reading in the electronic era. *Mind, Brain and Education*. 7, 200-211, doi:10.1111/mbe.12028
- Read, K. (2014). Clues cue the smooze: rhyme, pausing, and prediction help children learn new words from storybooks. *Frontiers in Psychology*, 5(February), 149-149. doi: 10.3389/fpsyg.2014.00149

- Rice, M. L. (1990). Preschoolers' QUIL: Quick incidental learning of words. In G. Conti-Ramsden & C. Snow (Eds.), *Children's language*. (Vol. 7, pp. 171–195). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Richels, C. G., Johnson, K. N., Walden, T., A., & Conture, E. G. (2013). The relation of socioeconomic status and parent education on the vocabulary and language skills of children who do and do not stutter. *J Commun Disord*, 46(4). doi: 10.1016/j.jcomdis.2013.07.002
- Rideout, V. J., Vanderwater, E. A., & Wartella, E. A. (2003). *Zero to six. Electronic media in the lives of infants, toddlers and preschoolers*. Menlo Park, CA: The Kaiser Family Foundation.
- Rohlfing, K. J., Grimminger, A., & Nachtigaller, K. (2015). Gesturing in joint book reading. In B. Kummerling-Meibauer, J. Meibauer, K. Nachtigaller, & K. Rohlfing (Eds.), *Learning from picturebooks*. Hove, UK: Routledge.
- Roy-Charland, A., Perron, M., Boulard, J., Chamberland, J., & Hoffman, N. (2015). "If I point, do they look?": The impact of attention-orientation strategies on text exploration during shared book reading. *Reading and Writing*, 28(9), 1285-1305. doi: 10.1007/s11145-015-9571-2
- Roy-Charland, A., Saint-Aubin, J., & Evans, M. A. (2007). Eye movements in shared book reading with children from kindergarten to Grade 4. *Reading and Writing*, 20(9), 909-931. doi: 10.1007/s11145-007-9059-9
- Segal-Drori, O., Korat, O., Shamir, A., & Klein, P. (2010). Reading electronic and printed books with and without adult instruction: Effects on emergent reading. *Reading and Writing*, 23, 913-930. doi: 10.1007/s11145-009-9182-x

- Segers, E., Takke, L., & Verhoeven, L. (2004). Teacher-mediated versus computer-mediated storybook reading to children in native and multicultural kindergarten classrooms. *School Effectiveness and School Improvement*, 15(2), 215-226. doi: 10.1076/sesi.15.2.215.30430
- Sendak, M. (1971). *In the night kitchen* (Red Fox 2001 ed.). UK: Random House Group Ltd.
- Sénéchal, M. (1997). The differential effect of storybook reading on preschoolers' acquisition of expressive and receptive vocabulary. *J Child Lang*, 24(1), 123-138.
- Sénéchal, M., Thomas, E., & Monker, J. A. (1995). Individual Differences in 4-Year-Old Children's Acquisition of Vocabulary during Storybook Reading. *Journal of Educational Psychology*, 218-229.
- Smith, L. B. (2003). Learning to recognize objects. *Psychological Science*, 14(3), 244-250. doi: 10.1111/1467-9280.03439
- Snow, C. E., Burns, M. S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.
- Son, J. Y., Smith, L. B., & Goldstone, R. L. (2008). Simplicity and generalization: Short-cutting abstraction in children's object categorizations. *Cognition*, 108(3), 626-638. doi: 10.1016/j.cognition.2008.05.002
- Stickland, P., & Stickland, H. (1994). *Dinosaur Roar!* UK: Random House Childrens Publishers.
- Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 11, 65-99.
- Sweller, J. (1989). Cognitive technology: Some procedures for facilitating learning and problem solving in mathematics and science. *Journal of Educational Psychology*, 81, 457-466.

- Tare, M., Chion, C., Ganea, P., & DeLoache, J. (2010). Less is more: How manipulative features affect children's learning from picture books. *Journal of Applied Developmental Psychology, 31*(5), 395-400. doi: doi:10.1016/j.appdev.2010.06.005
- Thom, E. E., & Sandhofer, C. M. (2009). More is more: the relationship between vocabulary size and word extension. *J Exp Child Psychol, 104*(4), 466-473. doi: 10.1016/j.jecp.2009.07.004
- Tse, L., & Nicholson, T. (2014). The effect of phonics-enhanced Big Book reading on the language and literacy skills of 6-year-old pupils of differen reading ability attending lower SES schools. *Frontiers in Psychology, 5*, 1222. doi: 10.3389/fpsyg.2014.01222
- Twomey, K., E., Ranson, S., L., & Horst, J. S. (2014). That's more like it: Multiple exemplars facilitate word learning. *Infant and Child Development, 23*(2), 105-122. doi: 10.1002/icd.1824
- Verhallen, M. J. A. J., & Bus, A. G. (2011). Young second language learners' visual attention to illustrations in storybooks. *Journal of Early Childhood Literacy, 11*(4), 480-500. doi: 10.1177/1468798411416785
- Wagner, L. (2013). By the numbers: a quantitative content analysis of children's picturebooks. *Frontiers in Psychology, 4*(850). doi: 10.3389/fpsyg.2013.00850
- Walsh, B. A., & Blewitt, P. (2006). The Effect of Questioning Style During Storybook Reading on Novel Vocabulary Acquisition of Preschoolers. *Early Childhood Education Journal, 33*(4), 273-278. doi: 10.1007/s10643-005-0052-0
- Wasik, B. A., Hindman, A. H., & Snell, E. K. (2016). Book reading and vocabulary development: A systematic review. *Early Childhood Research Quarterly, 37*, 39-57. doi: 10.1016/j.ecresq.2016.04.003

- Waxman, S. R., Hermann, P., & Woodring, J. (2014). Humans (really) are animals: Picture-book reading influences 5-year-old urban children's construal of the relation between humans and non-human animals. *Frontiers in Psychology*, 5(172). doi: 10.3389/fpsyg.2014.00172
- Werchan, D. M., & Gómez, R. L. (2014). Wakefulness (not sleep) promotes generalization of word learning in 2.5-year-old children. *Child Development*, 85(2), 429-436. doi: 10.1111/cdev.12149
- Williams, S. E., & Horst, J. S. (2014). Goodnight book: sleep consolidation improves word learning via storybooks. *Frontiers in Psychology*, 5(MAR), 184-184. doi: 10.3389/fpsyg.2014.00184
- Wise Brown, M. (1947). *Goodnight Moon*: Harper.
- Zosh, J. M., Brinster, M., & Halberda, J. (2013). Optimal Contrast: Competition Between Two Referents Improves Word Learning. *Applied Developmental Science*, 17(1), 20-28. doi: 10.1080/10888691.2013.748420